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(54) **WIRELINE SUPPORTED BI-DIRECTIONAL SHIFTING TOOL WITH PUMPDOWN FEATURE**

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(58) **Field of Classification Search**
CPC E21B 23/03; E21B 23/06; E21B 23/08
USPC 166/381, 383, 385, 386, 387
See application file for complete search history.

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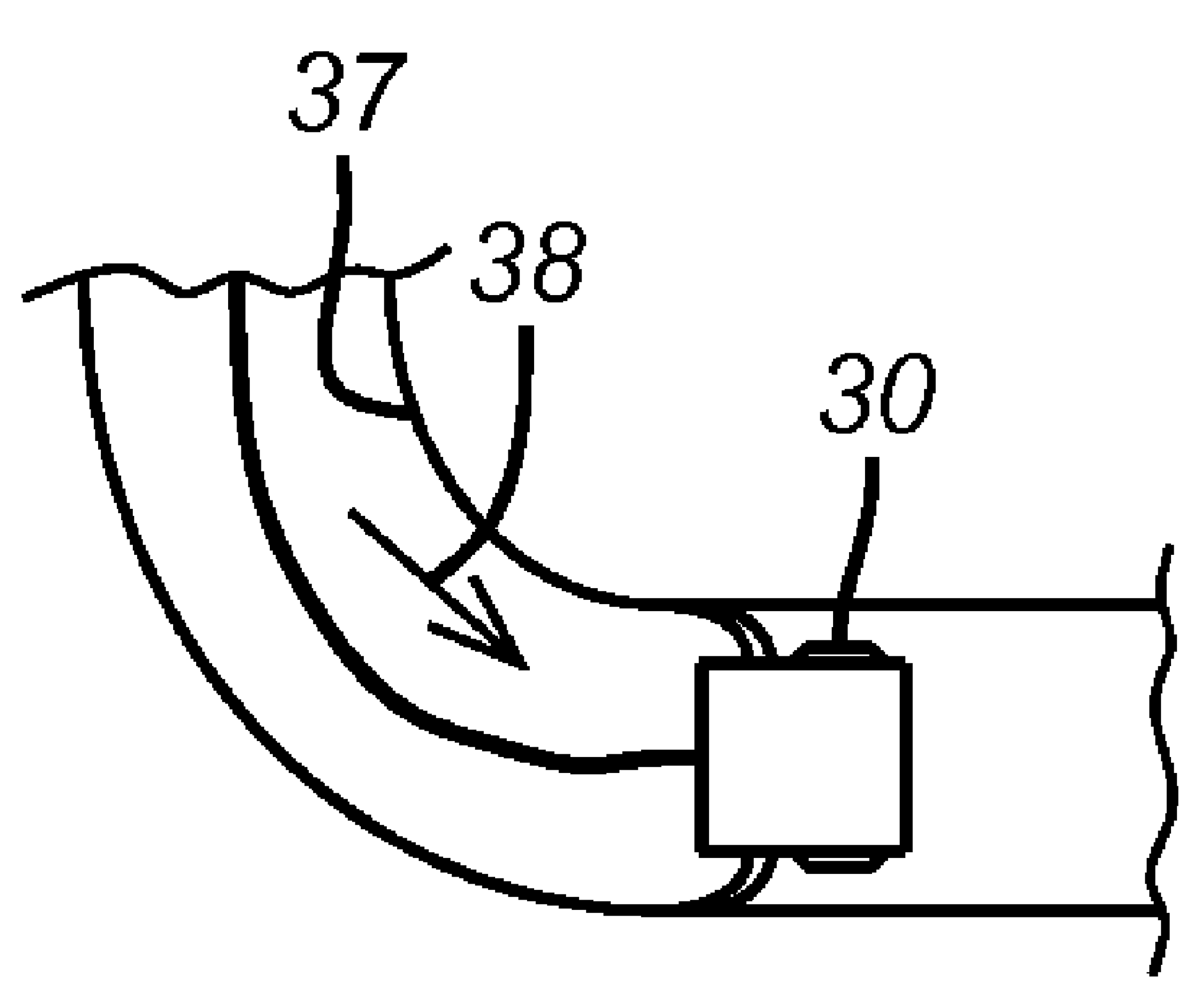
(57) **ABSTRACT**

A shifting tool for sleeves is supported on wireline or slickline and is pumped to the desired location by pressure from above delivered against the tool and passing around its periphery or against an articulated peripheral extending member that can optionally seal. Once in the vicinity of the desired sleeve to be shifted the shifting key is engaged to the sleeve and further applied pressure on the articulated peripheral seal shifts the sleeve in a downhole direction. The sleeve can also be shifted in an uphole direction with an anchor that grabs near the sleeve and a latch key that grabs the sleeve and is configured to retain grip as a motor moves the latch key uphole. Power can come from a wireline or can be locally provided if using slickline. The seal or extending member is retractable for tool removal or relocation.

10 Claims, 2 Drawing Sheets



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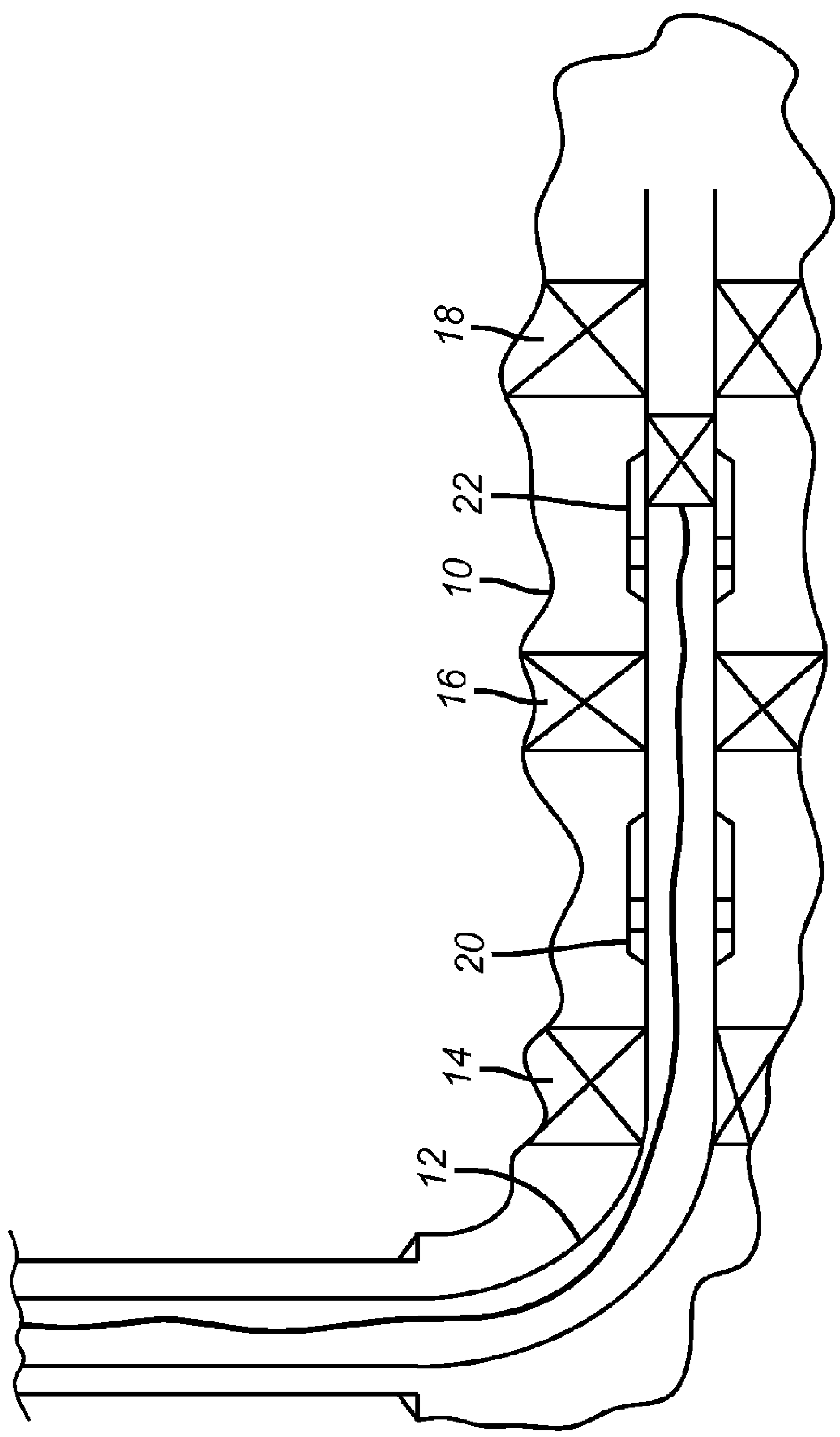

FIG. 1

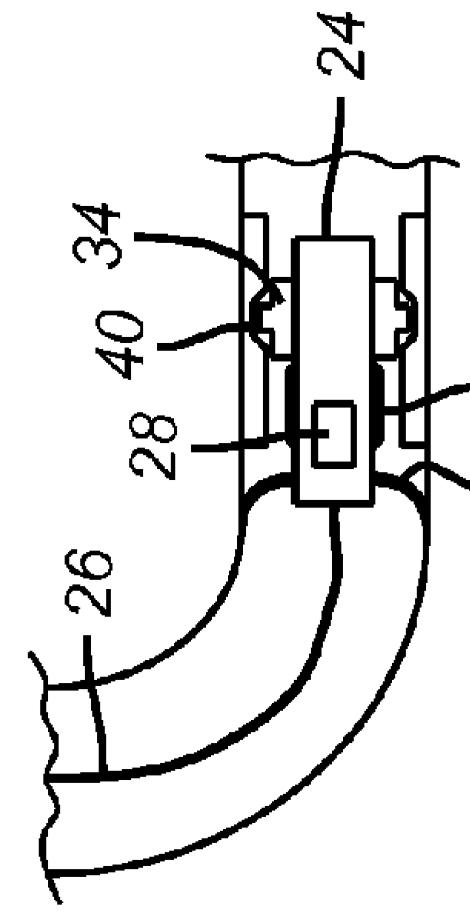

FIG. 3

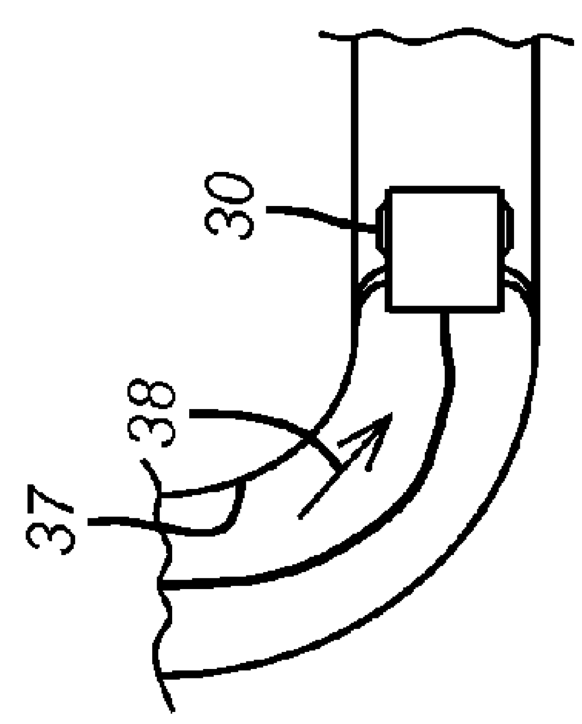

FIG. 2

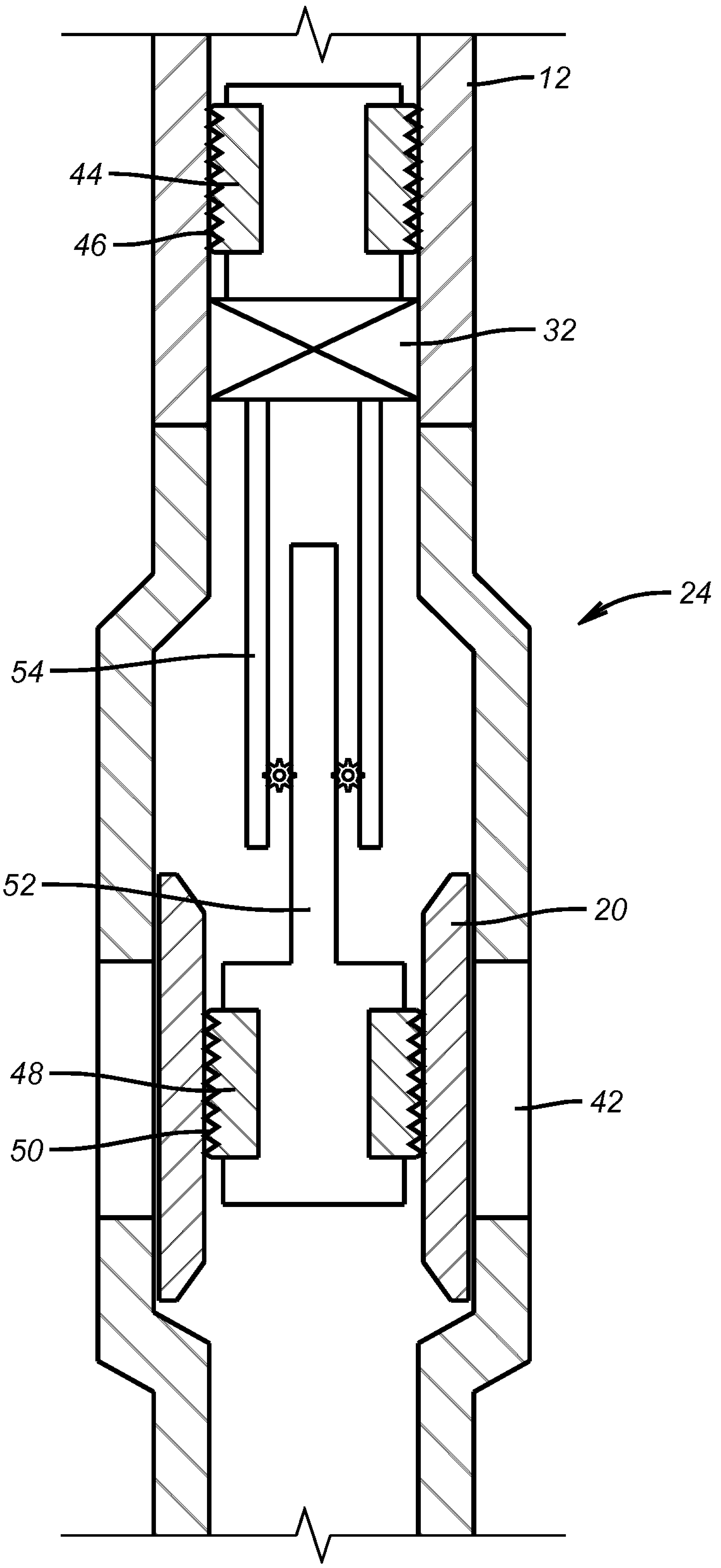

FIG. 4

WIRELINE SUPPORTED BI-DIRECTIONAL SHIFTING TOOL WITH PUMPDOWN FEATURE

FIELD OF THE INVENTION

The field of this invention is wireline run tools that can be delivered with pumped fluid for actuation of a subterranean tool and more particularly a series of sliding sleeves movable in opposed directions such as in a fracturing operation.

BACKGROUND OF THE INVENTION

Fracturing systems typically involve a series of sliding sleeve valves that are sequentially operated for fracturing a producing formation. These valves can be operated from the bottom up using ball seats on each sleeve where the balls get progressively bigger to land on a designated ball seat while passing through other seats that are bigger still. However, in installation that use many sleeves there is only a finite number of ball sizes that can be used for a given size of the completion string. There is also the matter of keeping track of what size ball has been dropped so that the order is not lost. This technique shifts sleeves in a single direction to open them relying on subsequent balls to isolate sleeves already open from a new sleeve being opened for fracturing a new location.

Wireline or slickline have been used to engage mechanical shifting tools to sleeves with shift keys that can then shift a sleeve between an open and closed position and another position in between for the purpose of pressure equalization, as illustrated in U.S. Pat. No. 5,305,833 and US Publication 2010/0282475.

Another technique is to run a motor with a ball screw drive that is connected to a sleeve so that power supplied to the motor from a wireline moves the sleeve in opposed directions as requires. This design is illustrated in U.S. Pat. No. 6,041, 857. Shifting tools have been delivered to a desired location by alternative techniques of lowering on a wireline or using a pumpdown technique as described in U.S. Pat. No. 3,552, 718. Another reference to the use of a pumpdown technique for injector valves is U.S. Pat. No. 4,494,608.

In some cases the desire to avoid wireline delivery and its limitations such as inability to advance in horizontal runs, inability to push and limited ability to pull tension has resulted in providing pressure responsive actuators with the sliding sleeves that are sensitive to application and removal of tubing pressure as shown in U.S. Pat. No. 7,617,875.

Other attempts to overcome the delivery shortcomings of wireline have involved using a rigid rod to deliver a shifting tool to shift a sleeve in opposed directions as shown in USP Publication 20100108323. Another approach has been to add a tractor system to a wireline run tool and located tractors at opposed ends for driving the tool in opposed direction such as shown in FIG. 16 of U.S. Pat. No. 6,543,538. Similar to the latter design is U.S. Pat. No. 7,150,318 FIGS. 5-10 that illustrated a pair of driven tracks at opposite ends of a shifting tool. After the tool latches to a sleeve a pressure control member 64 is allowed to extend and applied pressure is then used to shift the tool that is now latched to the sleeve. On opposite hand control member 222 is used for motion in the reverse direction with the tool latched to the sleeve. A similar concept of using pressure to latch and to shift an already delivered tool is shown in U.S. Pat. No. 7,556,102.

What is needed and provided by the present invention is a way to rapidly deploy a subterranean tool to a desired location using a pumping down technique while it is tethered to a wireline or slickline and then using power either stored

onboard if a slickline is used or delivered on a wireline to latch the subterranean tool such as a sliding sleeve. Once latched further applied pressure can shift the sleeve in one direction going further downhole. Shifting in the uphole direction is also envisioned with anchoring to the tubular near the sleeve while latched to the sleeve with another portion of the tool where relative movement takes the latched sleeve uphole toward the anchor set in the tubing wall near and above or below the sliding sleeve. These and other aspects of the present invention will be more readily apparent to those skilled in the art from a review of the detailed description and the associated figures while recognizing that the full scope of the invention is to be determined by the appended claims.

SUMMARY OF THE INVENTION

A shifting tool for sleeves is supported on wireline or slickline and is pumped to the desired location by pressure from above delivered against the tool and passing around its periphery or against an articulated peripheral extending member that can optionally seal. Once in the vicinity of the desired sleeve to be shifted the shifting key is engaged to the sleeve and further applied pressure on the articulated peripheral seal shifts the sleeve in a downhole direction. The sleeve can also be shifted in an uphole direction with an anchor that grabs near the sleeve and a latch key that grabs the sleeve and is configured to retain grip as a motor moves the latch key uphole. Power can come from a wireline or can be locally provided if using slickline. The seal or extending member is retractable for tool removal or relocation.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic depiction of the shifting tool pumped to the location on a slickline or wireline until engaged to a sleeve to be shifted;

FIG. **2** is an enlarged detail of FIG. **1** showing the articulated seal used to drive the tool to the desired location;

FIG. **3** is a more detailed view showing the grip key as well as the articulated seal of FIG. **2**;

FIG. **4** schematically illustrates a motor drive for the sleeve that is anchored to the tubular for sleeve shifting in either direction.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** illustrates an open hole **10** into which a string **12** extends. External packers **14**, **16** and **18** straddle respectively sliding sleeves **20** and **22**. Although two sliding sleeves are illustrated other quantities are envisioned with internal sliding sleeves being straddled with barriers such as packers on opposed sides while end sliding sleeves can have a packer on one side. For example a lowermost sliding sleeve can have a single packer above and no packer below. In this context above means closer to the surface or the wellhead and below means the opposite.

The shifting tool **24** is suspended on wireline or slickline **26**. If using a slickline there can be an onboard power module **28** for selective operation of sleeve **30** whose movement retracts or allows a peripheral seal such as a cup seal **32** to extend into a sealing position as shown in FIGS. **2** and **3**. Alternatively, if a wireline is used the power to operate sleeve **30** or the dogs **34** to engage a profile **36** on the sleeve such as **20** or **22** can come from the surface.

FIG. **2** illustrates the seal **32** that faces uphole in the deployed position with sleeve **30** retracted away from it allowing its shape to make the seal **32** jut out to engage the surrounding tubular wall **37**. Pressure applied from uphole indicated by arrow **38** pays out the wireline or slickline **26** as the shifting tool **24** is advanced. Movement of the tool **24** displaces fluid ahead of the tool **24** into the formation defining the open hole **10**. The approximate position of the tool **24** can be determined from the amount of line **26** that is paid out or from communication from a casing collar locator that counts collars. In open hole the amount of line **26** paid out is likely the preferred way to approximate the tool **24** location. Depending on the style of the latch key **34** engagement to the profile **40** on the sleeve **20** or **22** can be accomplished by passing the profile **40** then releasing the key **34** to extend and picking up until the profile **40** is engaged. Once that happens pressure represented by arrow **38** is re-established and the application of such pressure to the seal or packer cup **23** then will drive the sleeve **20** or **22** in the downhole direction in which arrow **38** is pointing.

Some variations are envisioned. The tool **24** can be longer and have on it a unique key assembly **34** that can fit the unique profile of each of the sleeves in the tubular **12** so that more than one sleeve such as **20** or **22** can be shifted in a single trip if desired. Seal **23** is preferably a packer cup but can be another type of seal with either internal pliability to be retracted such as when sleeve **30** is advanced over it. However the depiction of sleeve **30** and seal **32** is schematic and those skilled in the art will recognize that a radially articulated seal such as an inflatable can also be used. Some leakage past the seal **32** is tolerable as long as by differential pressure enough force is delivered to the dogs **34** when latched in profile **40** to shift the engaged sliding sleeve. While reference to a seal **32** is made it should be realized that other extending peripheral members around the tool **24** can be used to create the force on the sleeve such as **20** by simply substantially blocking the peripheral space about the tool **24** so that pumped fluid creates a shifting force large enough to move a sleeve such as **20** downhole using applied pressure from the surface despite some leakage flow.

It should be noted that the tool **24** can only be driven in the downhole direction with pressure **38** from the surface. However, the seal **32** can be retracted using sleeve **30** and the line **26** can be used to reposition the tool **24** in either direction. This is a different operation than trying to shift a sleeve such as **20** in an uphole direction where flow in the direction of arrow **38** will not be effective. One option is to engage a sleeve such as **20** and pull tension on the line **26**. However, this is not the optimal solution as the tension stress capacity of the line **26** could be reached before the sleeve such as **20** will budge in the uphole direction. FIG. **4** shows more detail of the tool **24** again in a schematic representation as to how the sleeve **20** can be moved in an uphole direction which is generally the direction for closing a port while movement of the sleeve **20** in the downhole direction is generally to open a port **42**. This can be reversed as in FIG. **4** where the port **42** is shown closed. One way to attain this position from when the port **42** is open is to anchor the tool **24** to the tubing **12** with an anchoring assembly **44** that can comprise of a series of extending members with wickers or hard facing **46** to grip the inside wall **37** of the string **12**. A second anchoring assembly **48** with external wickers **50** on segments that can be driven out radially is used to grab the sleeve **20**. The anchoring assembly **48** is on an actuator rod **52** and is operably connected to a drive system **54** that is schematically illustrated. The drive system **54** can be a motor that turns a ball screw to move the rod **52** in the desired direction. This actuation method can be a backup to using the seal **32** for movement of the sleeve **20** in a downhole direction. The seal **32** does not help when trying to move the sleeve **20** in an uphole direction so that the mechanism of FIG. **4** or other equivalents to it can be used for uphole motion of sleeve **20**. As alternatives the system **54** can be a solenoid that when energized moves the rod **52** in the desired direction against a spring return that takes over if the power to the motor is cut off. Electromagnets can be used to create a force to move the rod **52** to shift the sleeve **20**. Once the sleeve is shifted to the desired location then the anchoring assembly **48** can release the sleeve **20**. When the anchoring assembly **44** is then released the line **26** can then be used to reposition the tool **24**.

It should be noted that tractor drives are not used with the designs described above so that the tool is far simple and lighter than the prior designs that combine forward and rear tractor drives with a wireline. The pressure from the surface enables a wireline or slickline supported tool to be rapidly deployed to the desired locations and further enables pressure from above to be the actual driving force for tool operation. Although the preferred embodiment is a sleeve shifting tool **24** other types of tools are envisioned that can be rapidly deployed using an articulated seal or even a leaking peripheral barrier that produces a net force to propel the tool. Some examples are bridge plugs, anchors or fishing tools such as spears or overshots.

The above description is illustrative of the preferred embodiment and many modifications may be made by those skilled in the art without departing from the invention whose scope is to be determined from the literal and equivalent scope of the claims below:

I claim:

1. A method of delivery of a subterranean tool for use at one or more desired subterranean locations, comprising:
- supporting the subterranean tool on a wireline or slickline;
- inserting the subterranean tool into a borehole from a surface location;
- using pressurized fluid in said borehole to drive said subterranean tool to at least one desired location;
- engaging a movable component of an existing tool with said subterranean tool at said desired location;
- selectively anchoring the subterranean tool at a spaced relation to said movable component so that a portion of said subterranean tool is prevented from axial movement;
- using at least one sliding sleeve valve as said existing tool with the movable component;
- changing the length of said anchored subterranean tool with respect to a location where said subterranean tool is anchored with pressurized fluid at a further applied pressure to selectively shift said sliding sleeve in opposed directions for positions at opposed ends of travel and therebetween.

2. The method of claim **1**, comprising:
operating said subterranean tool with mechanical force.

3. The method of claim **1**, comprising:
- providing a peripheral articulated member on said subterranean tool;
- extending said member;
- creating a net force on said sliding sleeve with said mechanical force acting on said articulated member.

4. The method of claim **3**, comprising:
using a peripheral seal as said member.

5. The method of claim **4**, comprising:
using a packer cup or inflatable as said articulated member.

6. The method of claim **3**, comprising:
retracting said member before repositioning said subterranean tool in said borehole.

7. The method of claim **5**, comprising:
moving a sleeve over said packer cup to retract it.

8. The method of claim **1**, comprising:

using a plurality of sleeves with discrete profiles as said existing tool;

providing at least one latching key on said subterranean tool that can selectively latch to at least one sleeve.

9. The method of claim **8**, comprising:

providing a plurality of latch keys on said subterranean tool configured to engage discrete profiles of different sleeves in the same trip.

10. The method of claim **1**, comprising:

using a slickline with a power supply onboard said subterranean tool.

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